Abstract

Crystalline, or tethered, membranes have highly unusual properties, such as the absence of any finite elastic constants in the infrared limit, anomalous fluctuations even far away from any critical point, and a negative Poisson ratio.
Free standing graphene should be an excellent realization of a crystalline membrane, a notion which is supported by our analysis. We use non-perturbative renormalization group techniques to calculate the thermal fluctuations of graphene, based on a self-consistent calculation of the momentum dependent elastic constants of a tethered membrane.
Our calculation is in excellent agreement with Monte Carlo results for the the out-of-plane fluctuations of graphene. Ripples, the perhaps biggest surprise in the elastic properties of graphene, emerge naturally from our analysis. We further discuss new results on the crumpling transition of the membrane, at which it looses its orientational order.